(12) UK Patent Application (19) GB (11) 2 322 675 (13) A

(43) Date of A Publication 02.09.1998

(21) Application No 9803034.9

(22) Date of Filing 12.02.1998

(30) Priority Data
(31) 19707588 (32) 26.02.1997 (33) DE

(51) INT CL^6
F16D 7/04, B23B 45/00

(52) UK CL (Edition P)
F2C C1B2C C1B3B C1B5A C1B6B2

(56) Documents Cited
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(58) Field of Search
UK CL (Edition P) F2C
INT CL^6 B23B 45/00 45/16, F16D 7/04
ONLINE: WPI; EDOC

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(54) Abstract Title
A machine tool having a slip clutch

(57) A machine tool, eg drill or percussion drill or hammer drill, is provided with a slip clutch 32 comprising locking projections 28, on an end face of spur gear 21a, which engage with matching locking projections 29 on an end face of locking disc 30a. The locking projections 28 or 29 have return ramps 51, 57 which form a flatter angle β with a plane rotation 42 than associated torque transmission flanks 50, 55 that extend at a steeper angle α to the plane of rotation 42. This arrangement of ramps 51, 57 and flanks 50, 55 reduces noise levels and wear during clutch slippage and rotary impacts caused by the projection striking against one another may be used to unblock jammed tools. Spur gear 32 is freely rotatably mounted, via bearing bush 22, on intermediate shaft 23 and locking disc 30a is non rotatably but axially displaceably mounted, via splines 33, 34, on the shaft 23. A spring 36 axially displaces the locking disc 30a so that locking projections 50, 51, 55 and 57 engage.

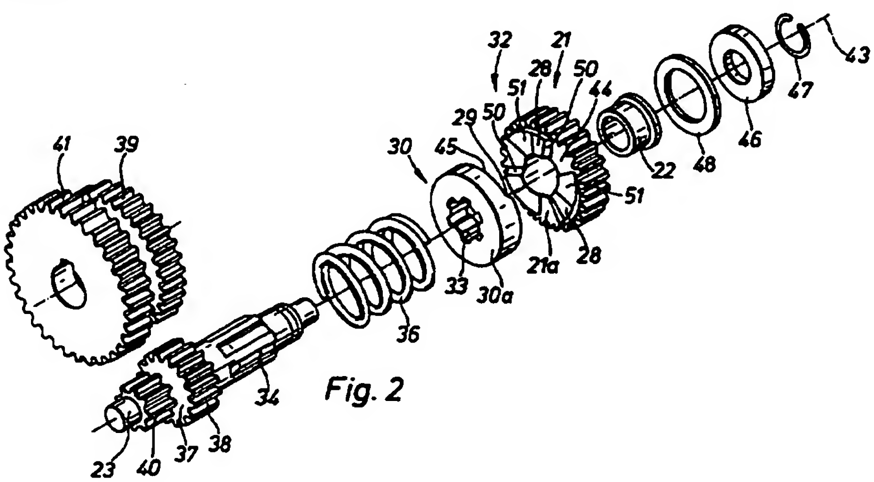

Fig. 2

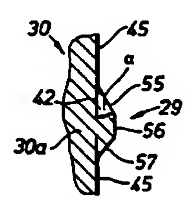

Fig. 4

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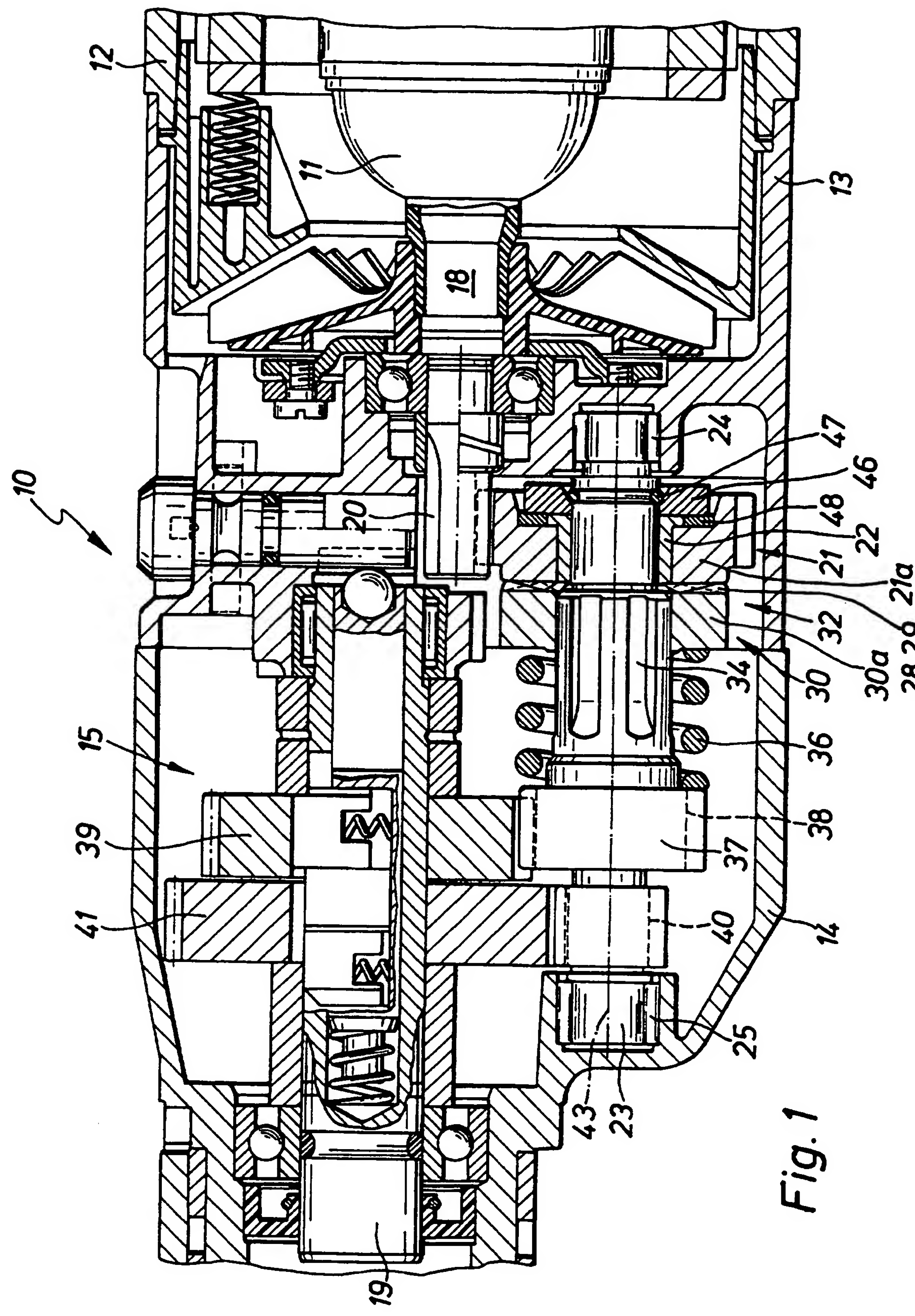
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Fig. 1

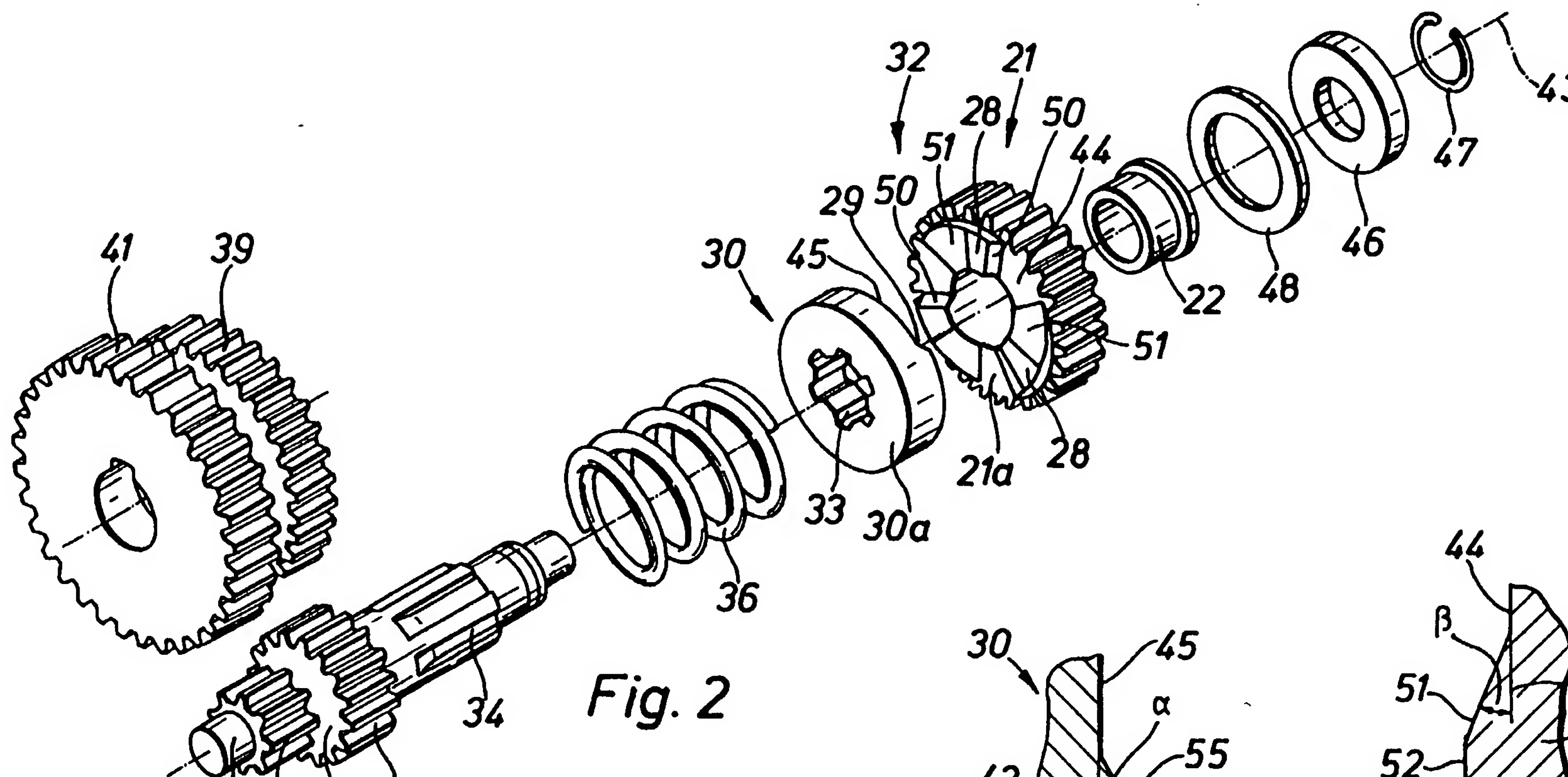

Fig. 2

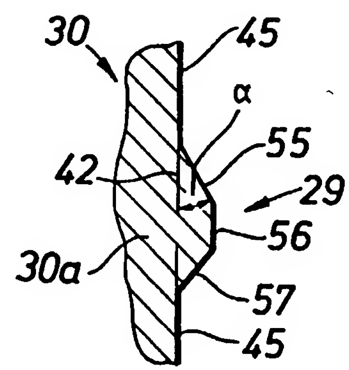

Fig. 4

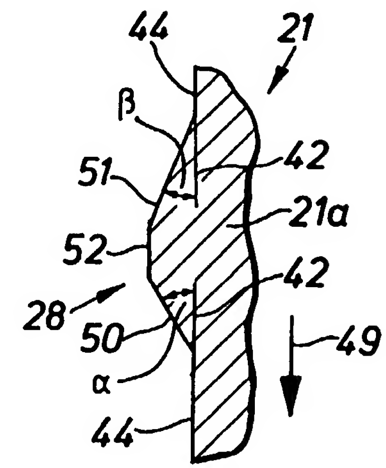

Fig. 3

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<u>Machine tool, more particularly a drilling machine and/or percussion drill or hammer drill</u>

State of the Art

The invention proceeds from a machine tool according to the preamble of claim 1. A machine tool is already known (DE 41 22 516 A1), in which a slip clutch is arranged in the rotary drive line. The slip clutch comprises two clutch elements, which are non-rotatably connected to one another via locking elements. A first clutch element constructed as a spur gear comprises locking recesses, in which the locking elements engage in order to transit torque. The spur gear is arranged so as to be axially displaceable and is forced by a compression spring in the direction of the second clutch element. Once the value of the torque to be transmitted by the slip clutch reaches the so-called slip moment, the slip clutch is triggered, the locking elements slipping relative to the first clutch element. In order to protect the user, it is intended that the slip clutch responds, for example, if a drilling tool suddenly hooks or jams in the wall. As a result of the slip clutch, the drive torque acting upon the housing when the tool is blocked is limited to the slip moment.

The design of the movable clutch element as a spur gear can result in an undesirable dispersion of the slip moment. The provision of separate locking elements increases the number of parts and thereby increases the manufacture and assembly costs of the clutch.

Furthermore, a slip clutch is already known on the market in which the spur gear is constructed on the axially stationary clutch element. The slip clutch comprises a plurality of locking projections and locking recesses, which are symmetrical in construction. The known slip clutch is relatively susceptible to wear, since the

clutch elements impact axially against one another following slippage. This also produces disturbing slip noises.

Advantages of the invention

The machine tool according to the invention having the features of claim 1 offers the advantage that disturbing noises and wear are prevented during slippage of the slip clutch.

The measures disclosed in the dependent claims allow for advantageous further developments and improvements of the machine tool according to the invention. It is particularly advantageous to arrange only two to four locking projections uniformly distributed in the circumferential direction on each clutch element, since this reduces the slip frequency and therefore stress to the components. Following slippage, the slip clutch locks in again fully. The rotary impacts generated as the locking projections strike against one another again can be used to unblock the jammed tool.

As a result of a bearing bush fitted between the spur gear and the shaft or protective disk, the bearing friction can be reduced, which additionally increases the service life of the slip clutch. In addition, blows to the spur gear generated during the slip procedure are damped. The slip clutch can also be assembled in a particularly simple manner.

Drawings

An embodiment of the invention is illustrated in the drawings and explained in further detail in the following description. Figure 1 is a longitudinal section through a gearing of a machine tool, Figure 2 is a perspective assembly view of a slip clutch

and Figures 3 and 4 are each partial sections through corresponding locking projections of the slip clutch.

Description of the embodiment

In Figure 1 the reference numeral 10 designates a drilling machine as an example of a machine tool. The drilling machine 10 is used, for example, for drilling using diamond drill bits and to this end can either be manually guided or clamped in fixed fashion in a drill stand. The drilling machine 10 is provided with a drive motor 11, which is accommodated in a motor housing 12. Adjoining the motor housing 12 is a two-part gearing housing 13, 14, in which a gearing 15 of the drilling machine 10 is disposed. The gearing 15 is arranged in the rotary drive line between a motor shaft 18 of the drive motor 11 and a rotary spindle 19, which is non-rotatably connected to a tool holder, not shown in further detail. At its end, the motor shaft 18 is non-rotatably provided with a pinion 20, which engages with the toothing of a spur gear 21a.

The spur gear 21a is rotatably arranged on an intermediate shaft 23 by means of a bearing bush 22 freely arranged on the intermediate shaft 23. The intermediate shaft 23 in turn is rotatably mounted in the gearing housing 13, 14 via needle bearings 24, 25. The spur gear 21a is provided on its end face with locking projections 28 and locking recesses 44, which cooperate with matching locking projections 29 and locking recesses 45 on a locking disk 30a. The spur gear 21a forms a first, axially fixed clutch element 21 and the locking disk 30a forms a second, axially displaceable clutch element 30 of a slip clutch 32. To this end, the locking disk 30a is non-rotatably coupled via a spline shaft profile 33 arranged on its inner side with a matching spline shaft profile 34 arranged on the outer circumference of the intermediate shaft 23. The spline shaft profile 34 has a larger axial extension than the spline shaft profile 33 of the locking disk 30a, which allows

for an axial displacement of the locking disk 30a whilst maintaining the rotary lock between the locking disk 30a and the intermediate shaft 23.

A compression spring 36 is supported at one end against a collar 37 of the intermediate shaft 23 and at its other end acts with spring force upon the locking disk 30a in the axial direction towards the spur gear 21a. The collar 37 is provided with radial toothing 38, which engages with the toothing of a gear wheel 39, which is non-rotatably arranged on the rotary spindle 19. Provided on the intermediate shaft 23 is a further toothing 40, which engages with the toothing of a second gear wheel 41 on the rotary spindle 19. The gear wheels 39, 41 can be selectively non-rotatably coupled with the rotary spindle 19 via a switching mechanism, which will not be described in further detail since it is not the subject matter of the invention. The toothing pairs 38/39 and 40/41 thus form a shift gearing having two gear stages.

When the slip clutch 32 is engaged, the locking projections 28 on the spur gear 21a are rotationally offset relative to the locking projections 29 on the locking disk 30a, so that the locking projections 28, 29 are each forced by the compression spring 36 into the interposed locking recesses 44, 45. In this respect, the force of the compression spring 36 is transmitted via the locking disk 30a to the spur gear 21a and via a support ring 46, which is axially secured on the intermediate shaft 23 by means of a securing ring 47, is received by the intermediate shaft 23. Arranged between the end face of the spur gear 21a facing away from the locking disk 30a and the support ring 46 is a slide ring 48, which reduces the bearing friction acting upon the spur gear 21a during the continuous drive.

Figure 2 shows the assembly sequence for the components of the slip clutch 32. Firstly, the compression spring 36 is pushed over the end of the intermediate shaft 23 provided with the spline shaft profile 34. The locking disk 30a is then positioned on the intermediate shaft 23 in such a manner that the spline shaft profiles 34, 35

engage with one another. The spur gear 21a together with the bearing bush 22 is then pushed onto the intermediate shaft 23 and secured axially via the slide ring 48, the support ring 46 and the securing ring 47.

In the exemplary embodiment, three locking projections 28 are uniformly distributed in the circumferential direction on the end face of the spur gear 21a. Provided between the locking projections 28 are three corresponding locking recesses 44. The locking projections 28 comprises flanks 50, which are used for torque transmission with corresponding flanks 55 on the locking disk 30a when the slip clutch 32 is engaged. The flanks 50, 55 therefore lie opposite one another, viewed in the direction of rotation (arrow 49 in Figure 3).

Provided on the opposite side of the locking projections 28 are return ramps 51, on which the locking projections 29 of the locking disk 30a are guided into the adjacent recesses 44 following slippage. Slip regions 52 are formed between the flanks 50 and the return ramps 51.

Figure 3 is a side view of a locking projection 28 of the spur gear 21a. Between adjacent locking recesses 44 a flank 50 is firstly formed, which forms an angle α with the plane of rotation 42, which lies perpendicular to a rotary axis 43 of the intermediate shaft 23. Adjoining the flank 50 is the slip region 52, which lies approximately parallel to the end face of the spur gear 21a. Adjoining the slip region 52 is the return ramp 51, which forms an angle β with the plane of rotation 42.

The locking projection 29 shown in Figure 4 comprises the corresponding flank 55, a slip region 56 and a slip ramp 57. Whilst the flanks 50, 55 form approximately equal angles, the slip ramp 57 can be steeper than the return ramp 51. In order to damp the locking of the clutch elements 21, 30 following slippage, it is sufficient

for one of the locking projections 29 to comprises a flat return ramp 51. In principle, this can also be constructed on the locking disk 30a.

The function of the slip clutch 32 is as follows: Firstly, the two clutch elements 21, 30 of the slip clutch 32 are engaged during normal operation of the drilling machine 10, so that the torque is transmitted from the motor shaft 18 to the intermediate shaft 23 and via one of the toothing pairs 38/39 or 40/41 to the rotary spindle 19. If there is a jamming of the drilling tool during operation of the drilling machine 10, the flanks 50 of the locking projection 28 slide upon the flanks 55 of the locking projection 29, the locking disk 30a being axially displaced against the spring force 36. As soon as the axial displacement of the locking disk 30a corresponds to the axial height of the projection 28, the locking projections 29, 28 can slip. The locking projections 28, 29 are then guided along the return ramp 51 into the adjacent recesses 44/45. During the slip, the torque transmitted via the slip clutch 32 is considerably reduced, whilst the spur gear 21a continues to be rotatably driven by the drive motor 11, so that, after passing through the recess 44, the flanks 50, 55 impact against one another again. The resulting rotary impact can usually knock the jammed drilling tool free. If the drilling tool continues to jam, the slip procedure is repeated in corresponding fashion.

The invention is not restricted to the described embodiment. Thus, it is entirely possible to provide a larger or smaller number of locking projections 28, 29. It is particularly advantageous to distribute only two to four locking projections 28, 29 over the circumference, since in this manner the locking frequency of the slip clutch 32 can be reduced. The slip clutch 32 can be arranged on any shaft of the machine tool, in particular also on the rotary spindle.

Claims

1. Machine tool, more particularly a drilling machine and/or percussion drill or hammer drill, with a slip clutch (32) in the drive line between a drive motor (11) and a rotary spindle (19) which can be rotatably driven by the drive motor (11), locking projections (28, 29) being provided between a first clutch element (21) freely rotatably mounted but axially fixed on a shaft (23) and a second clutch element (30) non-rotatably mounted on the shaft (23) but axially displaceable against the force of a compression spring (36), which projections (28, 29) each engage in interposed locking recesses (44, 45) for torque transmission, characterised in that the locking projections (28, 29) of at least one of the clutch elements (21, 30) are provided with return ramps (51), which form a flatter angle (β) with a plane of rotation (42) of the respective clutch element (21, 30) than oppositely disposed flanks (50, 55) for torque transmission, which extend at a steeper angle (α) to the plane of rotation (42).

2. Machine tool according to claim 1, characterised in that two to four locking projections (29) are uniformly distributed in the circumferential direction on each of the clutch elements (21, 30).

3. Machine tool according to claim 1 or 2, characterised in that the axially fixed clutch element (21) is formed by a spur gear (21a), whilst the axially movable clutch element (30) is formed by a locking disk (30a).

4. Machine tool according to claim 3, characterised in that the shaft (23) is constructed as an intermediate shaft.

5. Machine tool according to claim 4, characterised in that the spur gear (21a) is rotatably mounted on the intermediate shaft (23) via a radial bearing, more particularly a bearing bush (22).

6. Machine tool according to claim 4, characterised in that the spur gear (21a) is axially supported on the intermediate shaft (23) via an axial bearing, more particularly a slide ring (48).

7. Machine tool according to claim 4, characterised in that the locking disk (30a) is non-rotatably secured on the intermediate shaft (23) via a spline shaft profile (33, 34).

8. Machine tool according to one of claims 4 to 7, characterised in that the compression spring (36) is supported directly against a single-part collar (37) of the intermediate shaft (23) and of the locking disk (30a).

9. Machine tool according to claim 8, characterised in that a radial toothing (38) is provided on the collar (37).

10. Machine tool according to one of claims 4 to 9, characterised in that the intermediate shaft (23) is integrally provided with spline shaft profile (34) and toothings (38, 40).

11. A machine tool substantially as herein described with reference to the accompanying drawings.

The Patent Office

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Application No:	GB 9803034.9	**Examiner:**	Mike McKinney
Claims searched:	1 to 11	**Date of search:**	24 April 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): F2C.

Int Cl (Ed.6): F16D 7/04; B23B 45/00 45/16.

Other: ONLINE: WPI; EDOC

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X; Y	GB 2185078 A	(LIAO) see, especially, 502,602 fig 1 and 17, fig 4.	X: 1, 2. Y: 5.
X	GB 1333841	(PURDY) see 30, 42 fig 2.	1 and 2.
X; Y	US 4854923	(SEXTON et al) see figs 3, 5 and 8, line 3 col 5.	X: 1, 2. Y: 5 and 6
X; Y	US 4159050	(HOPKINS et al) see 30, 31 fig 6 and lines 15 to 18 col 5.	X: 1-3. Y:6, 7 and 10.
X; Y	US 4062203	(LEONARD et al) see figs 1 to 5.	X:1 and 2. Y: 6.
X; Y	US 3967711	(STROEZEL et al) see figs and line 57 col 3 to line 57 col 4.	X: 1-4, 8 and 9 Y: 5, 6, 7 and 10.

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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